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A study of Farm Mechanics on Typical Farms in the North Cache High School District

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A STUDY OF FARM MECHANICS ON TYPICAL FARMS IN THE NORTH CACHE HIGH SCHOOL DISTRICT

by

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INTRODUCTION

The farmers of today are faced with many more and varied problems than were their grandfathers. This is in part due to the rapid mechanization of farming that has been developing during the past three decades. This movement for increased mechanization in farming presents a new challenge to farmers because of their responsibility in caring for farm machinery and maintaining it in an efficient operating condition. In effect, this means that the efficient farmer must devote an increasing amount of time and attention to the managerial and operative skills connected with mechanized farming. Moreover, he must acquire tools and equipment necessary to do what might be considered the ordinary repair and maintenance jobs on the equipment that is essential to his farming operations.

The state course of study in vocational agriculture for the rural high schools of Utah provides a training program for future farmers, young farmers, and adult farmers. One of the major aspects of this program is the care, repair and maintenance of farm machinery and equipment used on the farms. To be effective such a training program must be set up in terms of the needs of the farmers in the communities of the local high school district.

Various writers have been impressed with the fact that the farm mechanics training program in many of the high schools is more or less stereotyped without due consideration of the types of equipment in the local farming area and the skills required to repair and maintain this equipment properly. So far as is known, no study has been made of the

farm mechanics needs of individual farmers in the patronage area of any one high school district in the state of Utah. Present methods of building a program of study may or may not meet the needs of farmers and farm boys.

The purpose of this study is to make a survey of local farm conditions looking forward to a program of instruction in farm mechanics for high school boys, young farmers (out of school youth), and adult farmers.

The North Cache high school district is a typical farming area representing a diversified farm program. A survey of the farming conditions in this area should provide a means of building a functioning farm mechanics program suited to the needs of farmers, and furnish a pattern for other school districts of the state to follow. The problem to be investigated may be stated as follows:

PROBLEM.

"What are the farm mechanics needs of farmers in the North Cache high school district which should be used as a basis for organizing a program of instruction in farm mechanics for high school students and adults?"

PROBLEM ANALYSIS. For the purpose of study this problem may be divided into the following subsidiary problems.

1. What farm machines and equipment are used on the farms of the North Cache high school district?
2. What tools do farmers have on the farms?
3. What mechanical jobs and operations do farmers perform on the farms?

4. What mechanical jobs and operations do farmers recommend for the course of study in the local high school?
5. What mechanical skills should be included in the farm mechanics course of study for the high school district?

DELIMITATION. This study is limited to 50 - 60 farmers living in the North Cache high school district during the year 1948.

DEFINITION OF TERMS: VOCATIONAL AGRICULTURE. A nationwide program of systematic instruction in agriculture and farm mechanics of less than college grade conducted in public schools or classes for those persons over 14 years of age; who have entered upon or who are preparing to enter upon the work of the farm or of the farm home.

YOUNG FARMERS. Those men of post high school age, generally between the ages of eighteen and twenty five years, who have entered upon or who are preparing to enter the business of farming.

ADULT FARMERS. Those men, generally above 35 years of age, who have become established in the business of farming.

SETTING. The North Cache high school district includes a diversified farming area in the northern part of Cache county, Utah, in which are situated eleven communities ranging in size from 46 to 553 families. For the most part, farmers live within the limits of their incorporated towns and farm the areas outside. This presents a problem of transportation ordinarily not met in other areas.

REVIEW OF LITERATURE

Although some studies have been made in other areas, little has been written concerning the problem of determining the needs of farm mechanics instruction in the rural high schools of Utah. In 1923, Bebermeyer (2) conducted a study using a questionnaire which was sent to vocational agriculture teachers throughout Missouri, for distribution to parents of students registered in vocational agriculture. Of these questionnaires, 300 were returned and analyzed. This study revealed the fact that repair work on farm machinery was frequently necessary. Mowers, grain binders and cultivators headed the list of machines on which repair work was most often required. Bebermeyer also discovered that the tools to be found on the farms were indicative of both the extent and kind of repair and construction done by the farmers.

A similar study was conducted in 1928, at Iowa state college by Sharp (4). A questionnaire was sent through vocational agriculture teachers in Iowa to local farmers. The replies from the 500 returned questionnaires disclosed that, "Repair work is more important than construction work." (p. 14) Sharp discovered that the farmers recommended that the farm mechanics courses be made more practical by eliminating the construction of such projects as funnels, necktie racks, etc., which could be purchased more cheaply than could be made.

Walker (6) in 1931, sent questionnaires to 32 vocational agriculture teachers to distribute to farmers located throughout the state of Oregon. These questionnaires attempted to determine what the farmers thought should be taught in a farm mechanics course in high school, and to determine the jobs farmers actually do on their farms. The 200 returns

indicated that repair work on tractors and gas engines, and such jobs as sharpening saws were considered by the farmers to be important. The farmers, through their responses, indicated that woodwork, leather work, and glazing should receive much less attention than some of the instructors had given them. Walker discovered that repair work and operations were more important than new construction work. In comparing the results of this Oregon study and a similar one made in Iowa, he found that in the opinion of the farmers in the two states, the top five phases of farm mechanics work were repair of gasoline engines and tractors, tool sharpening, rope work, forge work, and machinery repair.

In 1932, Geiger (3) made a study of farm shop work in Florida by the questionnaire method, and received returns from 100 farmers. He also made a survey of the course of study being used in the high schools of Florida. Both the survey of tools and the course of study used indicated a considerable difference in farm shop jobs in various communities. It was revealed that the teacher of agriculture should study his community in order to determine what to teach. Farmers devote most of their work in the farm shop to repair jobs, while agriculture teachers devote most of their time to construction work. Geiger discovered that a considerable part of the farm shop repair and construction work in which a boy needs training could not be carried on at the school shop. (3, p. 86-87)

The interview technique was used in 1945 by Alampi (1), who made a study of a farm shop program for the Woodstown high school area of Woodstown, New Jersey. Using a questionnaire he interviewed 100 farmers located throughout the Woodstown high school area. Farmers were of the opinion that training should be offered in care and repair of farm machinery, farm motor mechanics, electricity, maintenance and repair of tools, concrete

and masonry work, blacksmithing, plumbing, welding, rope work, woodworking, repair and construction, farm engineering, and sheet metal and soldering. Repair and maintenance work ranked high in nearly all of the responses received.

Nearly all the studies reviewed disclose a need for more practical farm mechanics courses. They showed that more emphasis should be placed upon repair work than on new construction. In many cases there was a considerable variation between that which was taught and that which was needed by farmers and farm boys in the mechanics courses given by the high schools. They indicate that to insure an adequate program of farm mechanics instruction, a study should be made of the needs in the local communities served by the high schools.

METHODS OF PROCEDURE

It has been pointed out that a course of study in farm mechanics in a local high school should be constructed in terms of the needs of the farmers living in the local high school communities. To determine these needs satisfactorily in the present study, the writer undertook to answer the following questions.

1. What farm machines and equipment are used on the farms of the North Cache high school district?
2. What tools do farmers have on the farms?
3. What jobs and operations do farmers perform on the farms?
4. What jobs and operations do farmers recommend for the course of study in the North Cache high school?

Of the various devices available for such a study, it appeared that the questionnaire technique was the one best adapted to the purpose. Accordingly, a questionnaire was formulated to secure the desired information. This questionnaire was made up systematically to secure information concerning (1) general farm conditions, (2) machinery and equipment on the farms, (3) tools owned by farmers, (4) jobs performed, and specific recommendations by farmers as to what jobs should be taught in high school farm mechanics courses.

The survey form was then reviewed by members of a faculty committee, Professors LeGrande R. Humpherys, Agricultural Education; George T. Blanch, Agricultural Economics; Joseph L. Coulam, Agricultural Engineering, all of the Utah State Agricultural College. The changes suggested by these men were incorporated into a revised form. This revised form was then tested with representative farmers living in the area to be studied. These trial

surveys suggested a number of improvements in the questionnaire which were incorporated into a second revision. The second revision was again reviewed by the aforementioned committee and additional improvements were suggested. In the light of all suggestions and field trials, a final form (see Appendix) was drafted and mimeographed to serve as the instrument to be used in securing the data necessary to make the proposed study.

SAMPLING OF FARMS. A major problem in making the survey was, How shall we proceed to get the needed information? Should all farmers in the district be visited and, if not, how many? What farmers should be selected to insure securing reliable information concerning representative conditions on the farms?

Because of the time involved it appeared impracticable to visit all of the 1,222 farmers in the district. Since the farming in the North Cache high school district is to a large extent dry farming and diversified irrigated farming, it was thought that 60 farms properly selected would give a fair sample of the district and reveal with sufficient accuracy the needs and the judgment of the farmers concerning the desirable content of a course of study in farm mechanics. Out of 60 farms it was thought that 50 reliable surveys might be secured as a basis for obtaining the necessary information.

In order to secure what might be a fair sample of farms, a record was obtained from the United States 1940 census report of the 1,222 farmers living in the eleven communities within the North Cache high school district. The 60 farms to be used in the sample were prorated on a basis of each community's proportionate part of the total number of farmers in the district. After the number of farms to be surveyed in

each community had been determined, calls were made at farm homes indiscriminately in several parts of town until the allotted quota was filled.

Having selected the farms as outlined above, the writer, with the use of the questionnaire, visited all of the farmers personally and collected the needed data. These visits were made during the months of February and March of 1948. The procedure to be used in interviewing each farmer was very carefully worked out in writing and tested in the field for the purpose of securing, in a reasonable length of time, reliable and complete information bearing on the problem. Wherever there was any question of the reliability of the farmer's responses, the questionnaire was eliminated from the sample.

After eliminating all doubtful cases, 50 completed survey-questionnaires were retained for study. An analysis of the data gathered with significant deductions are presented in the following chapter.

ANALYSIS OF DATA

In the previous chapter the procedures and techniques were outlined for making a survey of 60 typical farms in the North Cache high school farming area. A check list was prepared, the 60 farms were visited, and the farmers were interviewed for the purpose of securing information necessary in organizing a program of instruction in farm mechanics for high school students and adults. Out of the 60 surveys made, 10 were eliminated because of one or more unreliable factors. The data from the remaining 50 surveys are analyzed in this chapter.

GENERAL INFORMATION.

The average age of the 50 farmers included in the survey was 47.5 years with a farming experience of 28.1 years. The farms in the survey averaged 199 acres with an average of 176 tillable acres.

Table 1 indicates the mean crop acreage per farm for the major crops which were grown on the 50 farms in 1948, and the percentage of farms which were growing the several crops. It will be observed that the major crops by acreage are wheat, hay, barley, sugar beets, and garden crops in the order named.

Approximately one fourth of the average tillable acres were devoted to grain crops. It may also be seen from Table 1 that nine out of ten farmers produced hay. The average acreage of row crops was small when compared with such crops as grain and hay.

Table 1. Acreage of crops grown

Crops	Mean acreage	Percent of farms with crops
Grains		
Wheat	76.0	70
Barley	31.6	74
Oats	9.7	36
Hay		
Tame hay	31.6	92
Row crops		
Sugar beets	8.6	50
Garden crops (sweet corn and peas)	7.5	30
Potatoes	5.7	12
Corn (silage)	5.4	30

The number and kind of livestock found on 50 farms in the North Cache school district is shown in Table 2.

Table 2. Number and kind of livestock

Animals	Mean number per farm	Percent of farms having animals
Dairy cows	11.5	88
Dairy heifers	9.7	84
Horses	2.8	80
Chickens	340.0	30
Beef animals	1.9	10
Turkeys	3000.0	2

It may be seen that one out of five farmers had no horses. Approximately seven out of eight farmers had dairy cows while five out of six had dairy heifers.

The number of farm laborers employed on the farms by months is shown in Table 3. An examination of the data indicates that only one out of three of the farmers employs men for the first three months of the year. During the six cropping months beginning with April, three

out of four farmers employ more than one man. The average is about 1.5 men per farm for these six months.

Table 3. Men employed per farm by months on the 50 farms surveyed*

Month	Mean number of men employed	Percent of farmers who employ men
January	1.08	32
February	1.08	32
March	1.07	34
April	1.22	46
May	1.22	74
June	1.50	76
July	1.45	76
August	1.53	82
September	1.52	76
October	1.58	58
November	1.27	56
December	1.29	54

* Men employed excludes the farmer and includes boys 16 years old.

MACHINERY, EQUIPMENT AND BUILDINGS ON FARMS.

The machines, equipment, and buildings found on the 50 farms included in the survey are tabulated in Table 4.

This information revealed that motor equipment was the most common of all of the various types of farm machinery. The farmers had on an average 66 percent of the five types of motor equipment included in the survey. Each farmer owned an average of one out of three of the machines for harvesting. More than 50 percent of the farmers owned rakes, hay derricks, mowing machines, and beet diggers. An average of 36 percent of all the tillage machinery listed was on each of the farms. Machines for planting were owned by fewer farmers than any of the other types of machines or equipment. Four out of five of the farms surveyed had tractors. One farm out of five had a farm shop. While four out of five of the farms had tractors, only two out of five had tractor mowers

or tractor cultivators. Nine farmers out of ten had automobiles. One out of five farmers had no sewage systems. All homes had plumbing and public utility electricity. Equipment for farm conveniences was owned by five farmers out of ten.

Table 4. Farm machinery, equipment and buildings

Item	Percent which had	Item	Percent which had
Motor equipment		Corn planter	24
Automobile	96	Beet planter	18
Electric motor	92	Potato planter	12
Tractor	80	Average	34
Truck	44	Miscellaneous machines	
Stationary gas engine	20	Wagon	82
Average	66	Manure spreader	60
Harvesting equipment		Ditcher	50
Dump hay rake	86	Trailer	42
Hay derrick	74	Hammer mill	14
Horse mowing machine	52	Irrigation pump	6
Beet digger	52	Lime spreader	2
Tractor mowing machine	46	Average	37
Side delivery hay rake	30	Farm conveniences	
Combine harvester	24	Plumbing system	100
Grain binder	20	Public utility electricity	100
Potato digger	14	Sewage system	78
Hay loader	10	Hot water tank	72
Ensilage blower	8	Milking machine	72
Average	38	Pressure water system	24
Tillage equipment		Milk can washer	8
Spike tooth harrow	92	Average	65
Tractor plow	80	Buildings	
Spring tooth harrow	62	Dairy barn	92
Horse cultivator	54	Garage	90
Disk harrow	48	Granary	64
Scraper	38	Poultry house	58
Hand plow	34	Implement shed	56
Riding plow	32	Chick brooder house	30
Tractor cultivator	28	Hog house	30
Disk plow	16	Horse barn	22
Cultipacker	16	Farm shop	22
Corrugator	4	Silo	22
Disk tiller	4	Open cattle shed	16
Weeder	2	Milk house	12
Average	36	Dairy lounge	8
Planting machines		Average	40
Grain drill	84		

Average in this Table refers to central tendency.

TOOLS OWNED BY FARMERS.

It was assumed when making the survey that all farmers would have access to such common tools as hammers, screwdrivers, punches, etc. Therefore, these tools were not included on the check list used in making the survey.

WOODWORKING TOOLS. Table 5 indicates the tools for woodworking and for sharpening found on the 50 farms visited.

Table 5. Woodworking tools and tools for sharpening

Tool	Percent which had	Tool	Percent which had
Woodworking tools		Bolt cutters	14
Hand crosscut saw	94	Miter saw	12
Ratchet brace	92	Winged dividers	10
Steel square	84	Buzz saw	10
Wood bit set	76	Electric table saw	10
Hand rip saw	74	Yankee drill	8
Ripping bar	68	Marking gauge	8
Wood chisel	64	Spoke shave	6
Carpenters level	62	"C" clamp	4
Carpenters plane	60	Power sander	4
Bench vise	60	Average	40
Hatchet	48	Tools for sharpening	
Draw knife	44	Electric grinder	50
Wood rasp	44	Saw files	28
Key hole saw	44	Saw set	22
Try square	42	Hand grinder	18
Steel tape	36	Auger bit files	16
Auger bit set	34	Saw vise	12
Coping saw	20	Average	24
Tee bevel	16		

Average in this Table refers to central tendency.

It will be observed that the farms, on an average, had one out of three of the woodworking tools. Farmers have, on an average, one out of four of the tools for sharpening.

FARM MOTOR REPAIR TOOLS. Table 6 indicates the extent to which the different types of farm motor equipment were found on the 50 farms surveyed.

Table 6. Farm motor repair tools

Tools	Percent which had	Tools	Percent which had
Grease gun	96	Piston ring compressor	8
Socket wrench set	90	Valve spring compressor	8
Automobile jack	82	Valve lifter	8
Assorted double end wrenches	82	Wheel puller	8
Crescent wrench	66	Rubber mallet	6
Thickness gauge	16	Micrometer	4
Offset screwdriver	14	Tappet wrench set	4
Machinists file	10	Auto electricians wrench set	2
Platinum point file	10	Average	28
Valve grinder	10		
Hoist	10		

Average in this Table refers to central tendency.

The farms visited had, on an average, nine out of ten of the common tools needed for engine lubrication and maintenance. The figures in Table 6 disclose that few of the farms possessed the tools and equipment to do many of the more technical motor repair operations such as fitting piston rings, grinding valves, etc. The average farm had one out of four of the tools listed for the repair of motors.

Table 7 shows the extent to which farms were equipped with adequate tools to do the hot and cold metal jobs on the typical farm.

Table 7. Tools for hot and cold metal work

Tools	Percent which had	Tools	Percent which had
Hot metal tools		Blow torch	16
Sledge hammer	62	Mill bastard file	8
Ball pein hammer	58	Average	32
Forge	20	Cold metal tools	
Steel faced anvil	18	Cold chisel	86
Bolt tongs	14	Set taps and dies	22
Anvil hardie	6	Monkey wrench	22
Blacksmith hot chisel	6	Machinist's vise	18
Average	26	Coarse grit grinder	16
Sheet metal and soldering		End nippers	16
Flat bastard file	82	Power press drill	14
Tinner's snips	38	Grinding goggles	12
Round file	32	Foot grindstone	8
Soldering coppers	26	Small steel square	4
Half round file	20	Average	22

Average in this Table refers to central tendency.

These figures disclose that the average farms visited had one out of four of the hot metal tools and one out of five of all of the cold metal tools. It is significant that only eight out of the fifty farmers had a power grinder and only one farmer in five had a forge. The average farmer had one out of four of the tools for sheet metal and soldering. A large majority of tools owned for doing sheet metal and soldering work consisted of files.

WELDING TOOLS ON FARMS. Data on the welding tools that were found on the farms included in the survey are summarized in Table 8.

Table 8. Welding tools

Tools	Percent which had	Tools	Percent which had
Electric welding		Acetylene welding	
Electric welder	8	Welder's goggles	6
Welder's helmet	6	Lighter torch	4
Welder's gloves	4	Oxy-acetylene welders	2
Supply cabinet	4	Average	4
Average	5		

Average in this Table refers to central tendency.

Only two farmers out of twenty-five had an electric welder and only one of the fifty farmers had an oxy-acetylene welder.

CONCRETE TOOLS. Inasmuch as concrete is playing an increased role in farm mechanics, it was thought advisable to determine how many of the farms were equipped with tools to do concrete work. A summary of the conditions on the 50 farms is contained in Table 9.

Table 9. Concrete tools

Tools	Percent which had	Tools	Percent which had
Trowel	24	Wooden float	8
Sidewalk edger	14	Screens	4
Concrete mixer	8	Sidewalk creaser	2
Metal float	8	Average	9

Average in this Table refers to central tendency.

The average farmer had one out of fourteen of the tools listed for concrete work.

PLUMBING AND MISCELLANEOUS TOOLS. Plumbing and miscellaneous tools found on the 50 surveyed farms are listed in Table 10.

Table 10. Plumbing and miscellaneous tools

Tools	Percent which had	Tools	Percent which had
Plumbing tools		Tools for riveting leather	48
Pipe wrench	82	Putty knife	18
Pipe cutter	4	Long extension bit	16
Stock and die set	4	Post hole digger	14
Pipe vise	2	Electrician's pliers	10
Average	23	Tools for stitching leather	10
Miscellaneous tools		Corner brace	2
Wire stretcher	70	Glass cutter	2
Fencing pliers	62	Average	28
Insulated screwdriver	52		

Average in this Table refers to central tendency.

One half or more of the farmers had pipe wrenches, pliers, insulated screwdrivers, and wire stretchers. Few farmers had the other common plumbing tools.

FARM MECHANICS JOBS PERFORMED.

Thus far in this chapter, an analysis has been made of the extent to which the inventories of 50 typical farms of the North Cache high school district include farm machines, equipment, buildings, tools, and farm conveniences. In the remaining part of the chapter an analysis will be made of: (1) the extent to which farmers did typical farm mechanics jobs, (2) reasons for not doing these jobs when they were not done, and (3) the jobs which, in the opinion of the farmers, should be taught in the high school course of instruction. The data dealing with these three aspects of the study are summarized and analyzed in tables

11 to 20, inclusive.

GENERAL FARM MACHINERY JOBS PERFORMED. The farm mechanics jobs performed by farmers are listed in Table 11.

Table 11. General farm machinery jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N.					F.T.
		Reasons for not doing					
		Lack tools	Lack training	Lack time	Too technical	No need	
Selecting farm machinery	90	0	2	0	0	2	98
Minor farm machinery repairs	78	0	12	10	0	0	98
Major farm machinery repairs	58	20	40	12	2	2	98
Average	75	10	18	11	1	1	98

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

These data indicate that from 58 to 90 percent of the farmers select their own farm machinery and make both the major and minor repairs on the general farm machinery. The reasons given for not making such repairs are either lack of tools, lack of training, or lack of time. The farmers were almost unanimous (98 percent) in the recommendation that all these skills be included in the course of instruction.

Two out of five farmers lacked the training necessary to do major farm repairs and one out of five lacked the tools. The information in this table also shows that about one half of the farmers do not repair their own farm machinery.

WOODWORKING JOBS PERFORMED. The woodworking jobs that were done by the 50 farmers are itemized in Table 12. It is seen that an average of one out of two farmers did the jobs and operations listed. An average of four out of ten of the farmers lacked the training needed to

do the jobs. One out of twenty lacked the time.

Table 12. Woodworking jobs

Jobs and operations	F.D.	Numbers indicate percent F.N. Reasons for not doing: Lack tools	Lack training	Lack time	Too technical	No need	F.T.
Selecting farm buildings	72	0	20	6	0	2	98
Constructing small farm building fixtures and equipment	68	0	44	6	0	2	98
Building small farm buildings	62	4	30	4	0	2	100
Making sketches and drawings	58	4	34	6	0	0	98
Using a carpenter's level	54	4	36	6	2	0	94
Figuring bill of material	52	0	40	6	0	0	96
Laying out and leveling building sites	50	4	40	6	0	0	96
Cutting rafters	50	4	42	6	0	0	100
Building large farm buildings	46	6	44	6	0	2	96
Reading blueprints	44	0	48	6	2	0	90
Average	55	3	38	5	0	1	97

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

Nine out of ten of the farmers indicated that all the woodwork skills listed in the questionnaire and summarized in Table 12 should be included in the agricultural course of instruction. It is significant that all farmers interviewed recommended that cutting rafters and construction of small farm buildings should be taught. Even reading blueprints was considered important by 90 percent of the farmers.

MOTOR MECHANICS JOBS. Since farm motors are almost universally used on the farms, an effort was made to determine the extent to which farmers make the major repairs on this type of equipment. The results of this inquiry are summarized in Table 13.

Table 13. Motor mechanics jobs

Jobs and operations	F.D.	Numbers indicate percent F.N. Reasons for not doing: Lack tools	Lack training	Lack time	Too technical	No need	F.T.
Motor work							
Cleaning carburetor	28	8	64	12	4	0	98
Adjusting breaker points	26	10	66	10	4	0	100
Adjusting charging rate of generator	24	10	68	12	2	0	96
Locating ignition troubles	22	8	70	10	10	0	88
Installing new piston rings	20	8	68	12	10	0	90
Timing ignition	20	8	74	10	10	0	92
Adjusting valve tappets	20	10	66	12	6	0	94
Fitting new wrist pins	16	8	70	12	6	0	84
Taking up main bearings	18	8	76	10	4	0	90
Taking up connecting rods	16	8	74	0	4	0	88
Chassis work							
Lubricating chassis, etc.	68	0	12	12	10	0	88
Packing wheel bearings	42	8	52	8	10	0	88
Adjusting clutch	28	12	66	12	4	0	98
Focusing headlights	28	8	56	10	2	0	90
Adjusting front wheels	26	8	64	12	6	0	90
Selection work							
Selecting tractors	80	0	0	0	0	20	88
Selecting trucks	44	0	0	0	0	56	88
Selecting farm motors	36	0	48	12	12	6	84
Average	31	6	55	10	6	4	90

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

The responses indicate that farmers did on an average of one out of three of the motor repair jobs and operations included in the survey. Five farmers out of ten lacked training necessary to perform the surveyed jobs and operations. Less than 10 percent of the farmers felt that motor mechanics jobs and operations are too technical for farmers to perform. Nine out of ten of the farmers interviewed felt that all phases of motor work should be taught in high schools. Eight out of ten indicated that selection of farm motor equipment should be taught to

high school students, young farmers and adult farmers.

HOT AND COLD METAL JOBS DONE. In Table 14 are listed the hot and cold metal jobs and operations performed by farmers on the 50 farms studied.

Table 14. Hot and cold metal jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N.					F.T.
		Reasons for not doing					
		Lack tools	Lack training	Lack time	Too technical	No need	
Drawing and shaping metal	20	36	70	8	4	2	86
Upsetting	18	26	70	8	4	2	86
Tempering tool steel	16	26	74	8	4	2	86
Hot and cold riveting	14	26	76	8	4	2	88
Sharpening plow shares	14	24	74	10	4	2	82
Welding broken parts	14	24	78	6	4	2	94
Forge welding	12	26	74	8	4	2	88
Brazing broken parts	10	26	80	8	4	2	88
Using torch to cut metal	10	26	76	8	4	2	88
Welding cast iron	10	24	76	6	2	2	90
Welding steel	10	24	76	6	2	2	92
Welding with bronze	10	24	80	6	2	2	88
Bending and shaping sheet metal	34	16	48	4	0	10	72
Soldering	34	14	46	4	0	10	70
Average	16	24	70	7	3	3	85

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

This summary reveals that over half of the farmers interviewed lacked the training necessary to do the hot and cold metal jobs included in the check lists. Only 13 percent of the farmers did the hot and cold metal jobs listed. However, the farmers had 75 percent of the tools with which to do the jobs and operations. Over 70 percent of the farmers felt that all the welding, hot and cold metal, and sheet metal jobs should be taught in a farm mechanics course. Over one half of the

farmers possessed the training necessary to do the jobs related to sheet metal and soldering. One farmer out of three did the jobs and operations related to sheet metal and soldering.

HARNESS REPAIR JOBS PERFORMED. The harness upkeep and repair jobs done on the 50 farms surveyed are shown within Table 15.

Table 15. Harness repair jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N. Reasons for not doing					F.T.
		Lack tools	Lack training	Lack time	Too technical	No Need	
Washing	62	0	0	0	0	38	34
Oiling	42	0	0	10	0	44	34
Riveting	40	0	0	12	0	44	34
Stitching	10	4	0	8	0	44	34
Average	38	1	0	7	0	42	34

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

Farmers did 38 percent of the harness upkeep and repair jobs. Two thirds of the farmers felt that harness upkeep and repair jobs and operations should not be taught.

CONCRETE JOBS DONE. Table 16 is devoted to a consideration of the concrete jobs and operations done on the 50 farms.

The table shows that all farmers had a need for concrete work but they had performed only three out of four of the jobs listed. One farmer out of four lacked the training necessary to do the work. Eight out of ten felt that concrete work should be taught in high school.

Table 16. Concrete jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N.					F.T.
		Reasons for not doing					
		Lack tools	Lack training	Lack time	Too technical	No need	
Finishing	72	2	24	2	0	0	78
Patching	72	2	24	2	0	0	80
Reinforcing	72	2	24	2	0	0	78
Building floors and walks	72	2	24	2	0	0	78
Building upright structures	72	2	24	2	0	0	80
Walls and foundations	72	2	24	2	0	0	80
Average	72	2	24	2	0	0	79

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

PAINTING AND GLAZING JOBS DONE. Table 17 shows the painting and glazing jobs and operations done on the 50 farms surveyed.

Table 17. Painting and glazing jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N.					F.T.
		Reasons for not doing					
		Lack tools	Lack training	Lack time	Too technical	No need	
Painting interiors	78	0	14	2	0	8	62
Painting exteriors	78	0	12	2	0	10	64
Painting farm machinery	78	0	12	2	0	10	64
Cutting glass	50	0	12	2	0	32	54
Preparing sash and fitting glass	50	0	12	2	0	32	52
Applying putty	50	0	12	2	0	32	52
Average	64	0	12	2	0	20	58

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

Farmers, on an average, did two out of three of the painting and glazing jobs and operations included in the survey. They performed four

out of five of the painting jobs and operations, but more than one half of the farmers were of the opinion that all of the jobs should be included in a course of instruction in farm mechanics.

ELECTRICAL JOBS DONE. Table 18 shows the electrical jobs and operations that were performed on the 50 farms.

Table 18. Electrical jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N.					F.T.
		Reasons for not doing					
		Lack tools	Lack training	Lack time	Too technical	No need	
Making minor repairs	64	0	30	0	4	2	82
Doing simple wiring	62	0	24	0	2	2	82
Installing simple electrical outlets	62	0	32	0	4	2	82
Repairing electrical appliances	56	0	38	0	2	4	78
Replacing motor brushes	46	0	46	0	2	6	78
Reading a meter	32	0	58	0	2	4	74
Average	54	0	38	0	3	3	79

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

The average farmer did one half of the electrical jobs and operations, but two thirds of the farmers had the training necessary to do those jobs and operations, and 90 percent of the farmers were of the opinion that all of these jobs should be included in a course of study.

POWER TRANSMISSION JOBS DONE. Table 19 shows the number of farmers doing the jobs and operations related to the transmission of electrical power.

Table 19. Power transmission jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N.					F.T.
		Reasons for not doing					
		Lack tools	Lack training	Lack time	Too technical	No need	
Splicing belts	30	0	36	4	0	30	54
Calculating size and speed of pulley	18	0	46	6	0	32	56
Average	24	0	41	5	0	31	55

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school.
Average in this Table refers to central tendency.

Less than one third of the farmers performed the skills listed, six out of ten possessed the training needed to do the power transmission jobs, and about one half of them felt that some instruction should be given in jobs involving power transmission.

FARM ENGINEERING JOBS DONE. An effort was made to determine the farm engineering jobs which farmers did. The results of this part of the survey are recorded in Table 20.

Table 20. Farm engineering jobs

Jobs and operations	Numbers indicate percent						
	F.D.	F.N.					F.T.
		Reasons for not doing					
		Lack tools	Lack training	Lack time	Too technical	No need	
Laying out a field	86	0	8	0	0	8	86
Preparing land for irrigation	82	0	6	0	0	10	82
Finding area of land	80	0	30	0	0	6	86
Leveling floors and foundations	68	0	26	0	0	6	84
Laying out tile drains	42	0	20	0	0	34	70
Finding elevation differences	30	0	44	4	0	22	80
Constructing erosion checks	24	0	34	0	0	42	64
Determining capacity of ditches and laterals	22	0	32	6	0	40	64
Average	54	0	25	1	0	21	77

F.D.-Farmers doing
F.N.-Farmers not doing
F.T.-What farmers thought should be taught in high school
Average in this Table refers to central tendency

6

On an average, the farmers did five out of ten of the engineering jobs and operations listed, and one farmer out of five had no need to do the jobs or operations. One farmer out of four lacked the training necessary to do the jobs. Approximately 80 percent of the farmers thought that all of the farm engineering jobs and operations listed in the table should be included in a course of farm mechanics for high school. Leying out tile drains, determining the capacity of ditches and laterals, and construction of erosion checks seemed to be considered of little importance.

CONCLUSION

GENERAL AGRICULTURAL SITUATION. The typical farmer in North Cache is middle aged with 28 years of farming experience. In many cases the farmers live in town and farm outside of town. This condition in itself gives rise to a problem of transportation back and forth between the farm and the home. It may also influence the extent to which the farmer uses the services of the local town mechanic.

The farming in this area is diversified. The major crops are wheat, hay and barley. Dairying is the major livestock enterprise. There are few horses on the farms and the farming is highly mechanized. During the months of December, January and February, the farmers employ few laborers and have time and the desire in most cases to repair and maintain the machinery and equipment on the farms.

MACHINERY, EQUIPMENT, BUILDINGS, AND CONVENIENCES ON THE FARM. The typical farm has a great variety of machines as shown in Table 4. Hence, the financial investment in machinery and equipment is large. If this investment is to be protected, the problem of repairs and maintenance is immediately a major problem on every farm in the district. If efficient management procedures are practiced, the farmer must do the work in the slack season or have the work done by local service stations. The question of teaching the farmer how to repair and maintain his own machinery is the problem under consideration.

The order of frequency of farm machines on these 50 farms was: automobile, electric motor, spike tooth harrow, hay rake, grain drill, wagon, tractor, tractor plow, hay derrick, spring tooth harrow, manure spreader,

horse cultivator, horse mowing machine, beet digger, ditcher, disk harrow, tractor mowing machine, trailer, scraper, hand plow, and related equipment. The machines above listed are used on from 33 to 96 percent of the farms. The farms had on an average 65 percent of the farm conveniences. This means that the repairs and maintenance of all these machines and equipment is a problem on a substantial number of the farms.

The analysis of the summarized data indicates that one-half of the farmers do their own major farm machinery repairs, three out of four do the minor repairs, and two out of five lack the training needed to do the major repairs. More important, over nine out of ten farmers felt that the instruction program should include the major and minor skills involved in repairing the machines on the farms. Even though 90 percent of the farmers select their own machinery, 98 percent of them thought this skill should be included in the farm mechanics instruction program. These deductions indicate what should be included in the program of instruction.

While more than 50 percent of the farmers had dairy barns, poultry houses, granaries, implement sheds and several other small buildings, one-third of the group lacked the training needed to do the woodworking jobs related to building construction, upkeep and repair. Perhaps this lack of training may, in part, explain why 96 percent of the farmers recommended that instruction be given in building construction.

The survey indicated that 56 percent of the farmers had implement sheds yet observations revealed that many implements were rusting as a result of the lack of proper housing. To overcome this loss farmers should be instructed concerning satisfactory facilities for adequate storage of farm tools and machinery. The adoption of this improved

practice would increase the useful life of the machinery and decrease the cost of maintenance.

TOOLS OWNED, JOBS PERFORMED, AND RECOMMENDATIONS OF FARMERS. An analysis of the data in Tables 4 to 10, indicates that the average farm had 23 percent of the tools necessary to do all the construction, maintenance, and repair jobs listed in the survey questionnaire. Furthermore, the data in Tables 11 to 20, inclusive, in the preceding chapter, indicates that the average farmer, performed 48 percent of all the jobs and operations listed in the survey form for all of the equipment on the farm. More significant in the solution of the problem of this study, 75 percent of all the jobs listed in Tables 11 to 20 should, in the opinion of these same 50 typical farmers, be included in the program of instruction for future farmers, young farmers, and adults in the North Cache high school district.

Three questions were posed in the survey of the 50 farms: (1) what jobs farmers perform, (2) reasons for not doing jobs not done, and (3) opinion as to what should be taught in a course of study. A brief summary is made here of the significant deductions from the responses to these questions in the several units of farm mechanics.

WOODWORKING. According to Table 5, the average farmer owns one-half of the more common woodworking tools. Significantly, a majority of the farmers expressed the desire for instruction in some of the common phases of building construction such as cutting rafters. Farmers could perform many of the woodworking skills and operations on their farms if they were encouraged to purchase additional common hand tools and were instructed in construction operations involving the use of such tools. On a basis of the expressed recommendations of these farmers for instruction,

the woodworking jobs and operations are listed in the following order of importance: cutting rafters, making sketches and drawings, figuring bill of material, laying out and leveling building sites, using a carpenter's level, and reading blueprints. From these data and other observations it would seem that instruction should be offered in construction of buildings and fixtures. This decision having been made, it would be desirable to introduce the fundamental principles and practices in the construction of large farm buildings in the program of instruction.

MOTOR MECHANICS. According to Table 6, the average farmer possessed only 28 percent of the tools and equipment necessary to perform motor mechanics jobs and operations. A majority indicated a lack of training and experience as the major reason for not doing such jobs. However, nine out of ten expressed a general interest in learning how to do motor mechanics jobs even though only one fifth of them possessed the equipment necessary to do the repair operations surveyed. This fact is important since repair of farm motors is more essential on many of the motorized farm machines. Of equal significance is the fact that 90 percent of the farmers expressed the opinion that all phases of motor mechanics work should be included in a program of instruction in farm mechanics.

The order of importance of skills in the motor mechanics unit as rated by the farmers and summarized in Table 14 are as follows: adjusting breaker points, adjusting and cleaning carburetor, adjusting charging rate of a generator, adjusting clutch, timing the valves, adjusting valve tappets, timing ignition, timing magneto, fitting new wrist pins, installing new piston rings, taking up main bearings, taking up connecting rods, packing wheel bearings, focusing headlights, lubricating chassis,

transmission and differential, installing new ignition wires, locating ignition troubles, selecting tractors, selecting trucks, selecting farm motors (internal combustion).

HOT AND COLD METAL. The farmers possessed an average of 16 percent of the tools and equipment necessary to perform hot and cold metal jobs and operations. Seventy percent of the farmers indicated a lack of training and experience as the major reason for not performing such work. These farmers expressed a desire to learn many of the operations and to see them taught in high school. It would seem that such a course may stimulate farmers to purchase or build the equipment themselves where such equipment is needed. The interest of the farmers in welding was high as expressed by the fact that nine out of ten felt that training should be given in welding. Farmers felt that such a course was important even though only seven percent of them possessed the tools necessary to perform welding operations. Eighty-five percent of the farmers felt that all phases of hot and cold metal work should be included in a program of farm mechanics.

One-third of the farmers had no grinder for sharpening tools. They should be encouraged to purchase satisfactory tool sharpening devices and have the benefit of instruction in some of the basic fundamentals in the sharpening of the more common tools. It would seem that many farm operations were retarded or not performed because of the lack of adequate tools for sharpening.

The following order of hot and cold metal jobs (Table 7) reflects the order of importance of skills in this unit in the opinions of the farmers: welding broken parts on farm implements, brazing broken parts

on farm implements, using a torch to cut metal, drawing and shaping metal, hot and cold riveting, sharpening plow shares, and sheet metal work.

PLUMBING. Although the plumbing jobs and operations done by the farmers were not included in the survey, the fact that all of the farms visited had plumbing installations would seem to indicate a need for some instruction in plumbing repair work. While 82 percent of the farmers had pipe wrenches, the survey showed that the average farmer had less than four percent of the other tools included in the check list. This indicates that little plumbing work was done by the farmers. However, with more tools and instruction, the farmer could do more of his general plumbing repairs.

CONCRETE. Seven out of ten farmers seemed to feel that a course in the fundamentals of concrete work should be given even though only eight percent had equipment to do concrete work.

PAINTING AND GLAZING. Fifty percent of the farmers did their own glazing and felt that some instruction should be given in it. However, many farmers felt that it was more convenient for them to take their work to the local glazier than to do it themselves and assume the risk of improper cutting of the glass or of glass breakage. It would seem that a course in the fundamentals of glazing would help give the farmers confidence in their own ability and result in a saving to themselves in time and money.

Three-fourths of the farmers did their own painting. Twelve percent expressed a need for training or experience, even though three-fourths of them do painting. It would be well to include a course of some of the

fundamentals of paint selection and uses. In view of the evidence of machinery rust and deterioration, farmers should be encouraged to do more painting especially of farm machinery and equipment.

ELECTRICITY. Ninety-two percent of the farmers had electric motors on their farms (Table 4). It is also observed (Table 20) that four out of five farmers replaced their own motor brushes and recommended that there should be some instruction given in electrical work. These facts seem to indicate that the fundamentals of simple wiring and minor electrical repairs should be included in the course of study.

POWER TRANSMISSION. Although 50 percent of the farmers (Table 19) felt that some instruction should be given in power transmission, the other 50 percent felt time for instruction could be better spent on some of the other phases of farm mechanics work. In view of these facts, time devoted to power transmission should be held to a minimum.

HARNESS REPAIR. Forty-eight percent of the farmers had tools for riveting leather and ten percent had the tools for stitching leather. However, there would seem little justification for spending much time on leather work since one out of five of the farms visited had no horses and nearly all farmers expressed the opinion that horses and harness work would soon be a thing of the past. However, since about one-third of the farmers visited did suggest instruction in harness work, it would seem that a limited amount of time should be spent on the major skills in this unit.

FARM ENGINEERING. Twenty-five percent or more of the farmers (Table 20) were able to measure the capacity of their ditches and laterals, and construct erosion checks. However, they felt that instruction should be

given in determining the capacity of ditches and laterals, construction of erosion checks, leveling floors and foundations, finding area of land, laying out a field, and preparing land for irrigation. In view of this sentiment it would seem that instruction should be offered in the fundamentals of all of the above mentioned phases of farm engineering.

THE FARM MECHANICS PROGRAM OF INSTRUCTION. In the foregoing analysis an effort has been made to bring together the important deductions derived from an analysis of the data presented in the previous chapter as they relate to an organization of a program of instruction in farm mechanics for the North Cache high school.

The program of instruction proposed in the following pages is organized in conformity with the conclusions above enumerated and the following accepted criteria:

1. The teacher of vocational agriculture should study his community in order to determine what to teach in farm mechanics.(3)
2. There is a close working relation between the extent and kind of repairs and construction work and the tools available on the farms.(2)
3. "A course of study should be based on the needs of the pupils to be taught and on the specific requirements of the occupation for which the instruction is given."(3) or, in words of another author, "The subject matter to be taught must be such as directly functions in the work for which the pupil is being vocationally trained."(7)
4. It is generally agreed that farming in this country is becoming increasingly mechanized and the capital investment for machinery

is increasing. This investment needs to be protected by proper repairs and maintenance.

5. New farm equipment and new devices makes it imperative that the school include a program of instruction in farm mechanics. No other institution can provide such systematic instruction.

6. In organizing a program of instruction consideration should be given to the expressed needs of those registering for the course.

7. When one-third or more of an enrolled group express a need for a certain instruction unit, it is considered good practice that such a unit be included in the program of instruction.

With due consideration to the conclusions enumerated and the seven controlling criteria, the program of instruction in farm mechanics is presented in Table 21 in terms of jobs and operations by major units.

Table 21. A proposed program of farm mechanics instruction for the North Cache high school district

Jobs and Operations
GENERAL FARM MACHINERY
1. Selection of farm machinery
2. Repair and replace worn and broken parts
3. Repaint machinery
4. General overhaul of farm machinery (5)
a. Spike tooth harrows
(1) Remove and sharpen teeth
(2) Replace teeth and adjust for depth
(3) Tighten all tooth clamps
(4) Replace drag links
(5) Tighten and adjust parts
b. Grain drills
(1) Test and lubricate feed shafts
(2) Replace worn chains or gears, pawls, and springs
(3) Adjust pressure springs, furrow openers, scrapers, and balance springs
(4) Calibrate drill

c. Plows
   (1) Adjust alignment of wheels
   (2) Replace worn wheel boxes
   (3) Adjust bail bearings, tension of lifting springs, and rear wheel scraper
   (4) Sharpen and adjust coulter and jointer
   (5) Set plow shares for down suck, land suck, and wing bearing
d. Spring tooth harrow
   (1) Sharpen and adjust teeth
   (2) Replace bearing of tooth bar in tooth bar standard
   (3) Repair or replace draft links
   (4) Tighten all parts
e. Manure spreader
   (1) Replace main drive pawls and springs in rear wheels
   (2) Inspect and clean out bearings of conveyer drive shaft
   (3) Straighten beater teeth
   (4) Repair conveyer chain
   (5) Clean and oil
f. Disk harrow
   (1) Test disk bearings for wear
   (2) Sharpen disk
   (3) Reassemble disk gangs
   (4) Tighten bolts or rivets in stub pole
   (5) Repair and adjust levers and snubbing block
   (6) Tighten all bolts
g. Mowers
   (1) Inspect countershaft bearing
   (2) Mesh bevel gear and pinion to proper depth
   (3) Inspect and replace crankshaft bearings
   (4) Examine spur gear and pinion
   (5) Remove wheels and clean roller bearings
   (6) Replace pawls and pawl springs
   (7) Inspect and replace wrist pins
   (8) Replace pitman box and straps
   (9) Replace sickle head
   (10) Replace worn guard plates, wearing plates, sickle clips
   (11) Align cutter bar
   (12) Align guards
   (13) Register sickle
   (14) Remove and sharpen sickle

WOODWORK AND BUILDING CONSTRUCTION

1. Identify woodworking tools
2. Identify, select and care for lumber
3. Make sketches and drawings of proposed projects
4. Make bills of material and figure quantities
5. Select and use wood fastenings, nails, screws and bolts
6. Select and use saws
7. Sharpen tools: chisels, knives, hatchets, screwdrivers, plane bits, steel drills, hand saws, auger bits, etc.
8. Plane and smooth wood

9. Construct wood projects
10. Fit tool handles
11. Use a carpenter's level
12. Determine requirements of various buildings
13. Select roofing materials
14. Lay out foundations for buildings
15. Construct forms for foundations
16. Place and align studding
17. Lay out and cut braces
18. Lay out and cut rafters
19. Fasten building parts
20. Repair buildings

FARM MOTOR MECHANICS

1. Clean the motor
2. Remove and inspect rocker arms and push rods
3. Remove cylinder head
4. Remove valve and tappet guides
5. Reface valve seats and grind valves
6. Replace valves
7. Remove crankcase pan
8. Remove pistons and connecting rods
9. Check wear of cylinders
10. Replace piston rings
11. Test and fit wrist pins
12. Align piston rods
13. Insert pistons
14. Replace pistons
15. Tighten connecting rods
16. Replace crankcase pan
17. Adjust breaker points
18. Clean and adjust carburetor
19. Adjust charging rate of generator
20. Adjust clutch pedal
21. Time ignition
22. Time magneto
23. Install new ignition wires
24. Focus headlights
25. Locate ignition troubles
26. Lubricate chassis, transmission, and differential
27. Select tractors
28. Select trucks
29. Select farm motors

HOT AND COLD METAL WORK

1. Light a blow torch
2. Tin soldering copper
3. Solder tin, iron, copper, and brass
4. Solder iron and steel
5. Sweat on a patch
6. Bend and shape sheet metal
7. Rivet sheet metal
8. Select and care for tools
9. Start and maintain a forge fire
10. Safety precautions

11. Measure and square materials
12. Draw and shape
13. Upset
14. Punch
15. Bend
16. Twist
17. Temper tool steel
18. Hot and cold riveting
19. Forge welding
20. Sharpen plowshares
21. Oxy-Acetylene welding
22. Oxy-Acetylene cutting
23. Electric welding

PLUMBING

1. Plumbing fittings and uses
2. Measure and figure material
3. Pipe cutting and reaming
4. Thread pipe
5. Fit pipe
6. Couple pipe
7. Faucet repair

CONCRETE WORK

1. Select and test sand and gravel
2. Calculate quantities of materials
3. Mix concrete
4. Pour concrete
5. Build forms for walks and floors
6. Build forms for walls and tanks
7. Reinforce concrete
8. Patch
9. Finish

PAINTING AND GLAZING

1. Paint machinery
2. Paint buildings
3. Measure and cut glass
4. Replace broken pane

ELECTRICITY

1. Run and splice wire
2. Do simple electrical wiring and install outlets
3. Read a meter
4. Clean and lubricate motors
5. Replace motor brushes
6. Repair electrical appliances

HARNESS REPAIR

1. Clean and oil
2. Rivet and stitch

ENGINEERING

1. Lay out tile drains
2. Construct erosion checks
3. Measure ditches and laterals
4. Locate fields
5. Determine area of land
6. Locate ditches
7. Level land
8. Level floors and foundations and find elevation differences

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The time allotment and time distribution for the various jobs and operations is not within the scope of this study. It is assumed that related information will be made a part of the instruction program and its place in the program will result from the judgment of a qualified teacher.

It is emphasized that the program of instruction above outlined includes the scope of units for three farm groups: future farmers in high school, young farmers, out of school youth, and adult farmers. Breaking up the units of instruction suited to each of these groups will involve such factors as present needs, difficulty season, etc. The solution of this problem is not involved in the present study but rests on the judgment of a trained teacher.

It is assumed that the farm mechanics instruction program in a high school is fundamentally instructional and not a "service station" to make the repairs of the farm machines of the community.

SUMMARY

1. To serve as a criterion for the formulation of farm mechanics program of instruction, a study by questionnaire was made in 1948, of the farm mechanics conditions on 50 typical farms of the North Cache high school district of Northern Utah.

2. The horse is disappearing from the farms in the North Cache high school district, the farms are becoming increasingly mechanized, and the farmers need training in mechanics.

3. Dairying was the most important animal enterprise and wheat, hay, and barley were the most important crops.

4. The months of December, January, and February represent the period in which farmers have most time to devote to farm mechanics work.

5. Farmers had the tools included in the survey check sheets in the following order of rank: woodworking, hot and cold metal, concrete and masonry, farm motor mechanics, miscellaneous, welding and plumbing.

6. Farmers lacked the training necessary to do two out of five of the major farm machinery repairs.

7. Farmers did an average of 46 percent of the farm mechanics jobs and operations in: farm machinery, woodwork, farm motor mechanics, hot and cold metal, painting and glazing, electricity, power transmission, and farm engineering.

8. Farmers lacked one out of ten of the tools necessary to perform the jobs and operations surveyed.

9. On an average, farmers lacked the training to do two out of five of the farm mechanics jobs and operations listed in the survey.

10. An average of one farmer out of twenty lacked the time needed to do the mechanical jobs and operations surveyed.

11. Farmers indicated, on an average, that eight out of ten of the jobs and operations surveyed should be taught in a high school course of farm mechanics instruction.

12. Care and repair of farm machinery and buildings was more important, in the opinions of the farmers surveyed, than construction operations.

APPENDIX

A survey of the extent of mechanization on typical farms
in the North Cache school district
by
Clifford G. Hansen

General Information

1. Name of the farmer_____ Address_____
2. Age of the farmer_____ 3. Farming tenure_____ 4. Size of the farm in acres_____
5. Number of tillable acres___ 6. Owner___, Renter___, Tenant___, Share Cropper_____
7. Number of boys_____, Ages_____, _____, _____, _____, _____, _____, _____, _____

8. List the acreage grown of the following crops:

_____Hay, tame	_____Garden Crops	_____Barley
_____Hay, wild	_____Corn (silage)	_____Oats
_____Orchard crops	_____Potatoes	_____Rye
_____Sugar beets	_____Wheat	_____

9. List the number of livestock owned:

_____Horses	_____Poultry	_____Beef animals
_____Dairy cows	_____Chickens	_____Sheep
_____Dairy heifers	_____Turkeys	_____

10. Men employed and total days:

January_____days_____	May_____days_____	September_____days_____
February_____days_____	June_____days_____	October_____days_____
March_____days_____	July_____days_____	November_____days_____
April_____days_____	August_____days_____	December_____days_____

General farm machinery and equipment

Check the machines and equipment on the farm. If more than one is owned, place the number in the blank opposite the name of the item.

1._____Automobile
2._____Baler, hay power
3._____Binder, grain
4._____Blower, ensilage
5._____Corrugator
6._____Cultipacker
7._____Cultivator, horse
8._____Cultivator, tractor
9._____Derrick, hay_____
10._____Digger, beet
11._____Digger, potato
12._____Ditcher
13._____Drill, grain
14._____Engine, gas (stationary)
15._____Fruit sprayer, hand
16._____Fruit sprayer, power
17._____Harrow, disk
18._____Harrow, spike tooth
19._____Harrow, spring tooth
20._____Harvester, combine
21._____Hoe, rotary
22._____Loader, hay
23._____Machine, milking
24._____Machine, mowing (horse)
25._____Machine, mowing (tractor)
26._____Mill, hammer
27._____Motor, electric, H.P._____
28._____Planter, beet
29._____Planter, corn
30._____Planter, potato
31._____Plow, disk
32._____Plow, hand
33._____Plow, riding
34._____Plow, tractor
35._____Pump, irrigation
36._____Rake, hay (dump)
37._____Rake, hay (side delivery)
38._____Rake, sweep (bull)
39._____Scraper
40._____Spreader, manure
41._____Stacker, overshot
42._____Thinner, beet
43._____Tiller, disk
44._____Tractor
45._____Trailer, _____tons
46._____Truck_____
47._____Wagon
48._____Weeder
49._____
50._____
51._____
52._____

Buildings and Equipment

1. _____ Barn, dairy
2. _____ Barn, horse
3. _____ Electricity, home plant
4. _____ Electricity, public utility
5. _____ Garage
6. _____ Granary_____
7. _____ House, brooder (chick)
8. _____ House, hog_____
9. _____ House, milk
10. _____ House, poultry
11. _____ Lounge, dairy
12. _____ Plumbing system
13. _____ Sewage system
14. _____ Shed, implement
15. _____ Shed, open (cattle)
16. _____ Shop, farm
17. _____ Silo_____
18. _____ Tank, hot water
19. _____ Washer, milk can
20. _____ Water system, pressure
21. _____
22. _____

Tools for sharpening

1. _____ Files, auger bit
2. _____ Files, saw
3. _____ Grinder, electric
4. _____ Grinder, hand
5. _____ Set, saw
6. _____ Stone, oil
7. _____
8. _____

Tools for wood working

1. _____ Bar, ripping
2. _____ Bits, wood (set)
3. _____ Bob, plumb
4. _____ Brace, rachet
5. _____ Chisels, bevel edge_____
6. _____ Clamps, "C"_____
7. _____ Clamps, bar
8. _____ Cutter, bolt
9. _____ Dividers, winged
10. _____ Drill, yankee
11. _____ Gauge, marking
12. _____ Hatchet_____
13. _____ Knife, draw
14. _____ Lathe, wood
15. _____ Level, carpenters
16. _____ Plane_____
17. _____ Rasp, wood
18. _____ Sander, power
19. _____ Saw, band, electric
20. _____ Saw, buzz (circle)
21. _____ Saw, coping
22. _____ Saw, hand cross-cut
23. _____ Saw, hand rip
24. _____ Saw, key hole
25. _____ Saw, miter
26. _____ Saw, table electric
27. _____ Set, auger bits
28. _____ Spoke shave
29. _____ Square, steel
30. _____ Square, try
31. _____ Tape, steel
32. _____ Tee bevel
33. _____ Vise, bench
34. _____ Vise, saw
35. _____
36. _____
37. _____
38. _____

Motor mechanics tools

1. _____ Compressor, piston ring
2. _____ Compressor, valve spring
3. _____ File, machinists
4. _____ File, platinum point
5. _____ Gauge, thickness
6. _____ Grinder, valve
7. _____ Gun, grease
8. _____ Hoist_____
9. _____ Jack_____
10. _____ Lifter, valve
11. _____ Mallet, rubber
12. _____ Micrometer_____
13. _____ Puller, wheel
14. _____ Reamer, ridge
15. _____ Screwdriver, offset
16. _____ Set, socket wrench
17. _____ Set, tappet wrench
18. _____ Set, wrench, auto electrician's
19. _____ Vise, piston
20. _____ Wrenches, assorted double end
21. _____ Wrench, crescent___, ___, ___, ____
22. _____
23. _____
24. _____

Hot and cold metal tools

1. _____ Anvil, steel-faced
2. _____ Chisel, blacksmith, cold
3. _____ Chisel, blacksmith, hot
4. _____ Chisel, cold
5. _____ Drill, breast
6. _____ Drill, chain 3" jaw
7. _____ Drill, power press
8. _____ Forge
9. _____ Goggles, grinding
10. _____ Grinder, coarse grit
11. _____ Grindstone, foot
12. _____ Hammer, ball pein_____
13. _____ Hammer, sledge_____
14. _____ Hardies, anvil
15. _____ Nippers, end
16. _____ Reamer, center high speed
17. _____ Rule, caliper
18. _____ Set, taps and dies
19. _____ Square, small steel
20. _____ Tongs, bolt
21. _____ Tongs, link
22. _____ Vise, machinist's_____jaws
23. _____ Wrench, monkey_____
24. _____
25. _____
26. _____

Welding tools

1. _____ Cabinet, supply
2. _____ Cutting attachment
3. _____ Gloves, welding
4. _____ Goggles, welder's
5. _____ Helmet, welder's
6. _____ Lighter, torch
7. _____ Regulator, acetylene
8. _____ Regulator, oxygen
9. _____ Table, firebrick top
10. _____ Tips, welding, assorted
11. _____ Welder, electric
12. _____
13. _____
14. _____

Sheet metal and soldering tools

1. _____ Blow torch
2. _____ Coppers, soldering
3. _____ File, flat bastard
4. _____ File, half round
5. _____ File, mill bastard
6. _____ File, round_____
7. _____ Snips, circular cutting
8. _____ Snips, tinner's
9. _____
10. _____

Tools for concrete and masonry work

1. _____ Concrete mixer_____
2. _____ Creaser, sidewalk
3. _____ Edger, sidewalk
4. _____ Float, metal
5. _____ Float, wooden
6. _____ Screens, 1/4" and 1" mesh_____
7. _____ Trowel_____
8. _____
9. _____
10. _____

Plumbing tools

1. _____ Cutter, pipe_____
2. _____ Reamer, pipe burr
3. _____ Stock and die set
4. _____ Vise, pipe
5. _____ Wrench, pipe_____, _____, _____
6. _____
7. _____
8. _____

Miscellaneous tools

1. _____ Bits, long, electrician's_____
2. _____ Brace, corner
3. _____ Digger, post hole
4. _____ Glass cutter
5. _____ Knife, putty
6. _____ Level and transit
7. _____ Pliers, electrician's
8. _____ Pliers, fencing
9. _____ Screwdriver, insulated
10. _____ Stretcher, wire
11. _____ Tools for riveting leather
12. _____ Tools for stitching leather
13. _____
14. _____

JOBS AND OPERATIONS

		1	a	b	c	d	3
1.	Which jobs and operations do you perform?						
2.	If you do not do it, check the reason why not.						
	a. Lack of tools						
	b. Insufficient training and experience						
	c. Lack of time						
	d. Other						
3.	Check which you feel should be taught to future farmers and adult farmers						
	General farm machinery						
1.	Doing minor farm machinery repairs (replacing ledger plates, pitman rods, rake teeth, etc.)						
2.	Doing major farm machinery repairs (replacing bearings, gears, bushings, overhauling motors, etc.)						
3.	Selecting farm machinery						
	Wood working operations						
1.	Making sketches and drawings						
2.	Cutting rafters						
3.	Figuring bill of material						
4.	Using a carpenter's level						
5.	Reading blueprints						
6.	Laying out and leveling building sites						
	Wood working jobs						
1.	Building small farm buildings (hog house, brooder house, poultry range shelter, etc.)						
2.	Building large farm buildings (poultry house, etc.)						
3.	Constructing small farm building fixtures and equipment (barn and shed doors, wagons, etc.)						
4.	Selecting farm buildings						
	Motor mechanics jobs						
1.	Adjusting breaker points						
2.	Adjusting charging rate of generator						
3.	Adjusting clutch						
4.	Adjusting and cleaning carburetor						
5.	Adjusting front wheels						
6.	Adjusting valve tappets						
7.	Fitting new wrist pins						
8.	Focusing headlights						
9.	Installing new ignition wires						
10.	Installing new piston rings						
11.	Locating ignition troubles						
12.	Lubricating chassis, transmission, differential						
13.	Packing wheel bearings						
14.	Selecting farm motors (internal combustion)						
15.	Selecting tractors						
16.	Selecting trucks						
17.	Taking up connecting rods						
18.	Taking up main bearings						
19.	Timing ignition						
20.	Timing magneto						
21.	Timing the valves						

JOBS AND OPERATIONS

1. Which jobs and operations do you perform? 1
2. If you do not do it, check the reason why not.
   a. Lack of tools a
   b. Insufficient training and experience b
   c. Lack of time c
   d. Other d
3. Check which you feel should be taught to future farmers and adult farmers. 3

Hot and cold metal

1. Brazing broken parts on farm implements
2. Drawing and shaping metal
3. Forge welding mild steel
4. Riveting, hot and cold
5. Sharpening plow shares
6. Tempering tool steel
7. Upsetting
8. Using torch to cut metal
9. Welding broken parts on farm implements
10. Welding cast iron
11. Welding steel
12. Welding with bronze

Sheet metal and soldering

1. Bending and shaping (corners, angles, seams, etc.)
2. Soldering (copper, black iron, galvanized iron, etc.)

Harness upkeep and repair

1. Washing
2. Oiling
3. Stitching
4. Riveting

Concrete and masonry work

1. Finishing (floating, troweling, honing, etc.)
2. Patching
3. Reinforcing

Building the following:

1. Floors and walks
2. Upright structures (tanks, troughs, etc.)
3. Walls and foundations

Painting and glazing

1. Painting interior of buildings, _____brush, _____spray
2. Painting exterior of buildings, _____brush, _____spray
3. Painting farm machinery, _____brush, _____spray
4. Cutting glass
5. Preparing sash and fitting glass
6. Applying putty

JOBS AND OPERATIONS

		1	a	b	c	d	3
1.	Which jobs and operations do you perform?						
2.	If you do not do it, check the reason why not.						
	a. Lack of tools						
	b. Insufficient training and experience						
	c. Lack of time						
	d. Other						
3.	Check which you feel should be taught to future farmers and adult farmers.						
	Electricity						
1.	Doing simple electrical wiring						
2.	Installing simple electrical outlets						
3.	Making minor electrical repairs (splicing, etc.)						
4.	Reading a meter						
5.	Repairing electrical appliances (toaster, etc.)						
6.	Replacing motor brushes						
	Power transmission						
1.	Calculating size and speed of pulley						
2.	Splicing belts, _____, _____, _____,						
	Farm engineering						
1.	Constructing erosion checks						
2.	Determining the capacity of ditches and laterals						
3.	Finding elevation difference between two points						
4.	Finding area of land						
5.	Laying out a field						
6.	Laying out tile drains						
7.	Leveling floors and foundations						
8.	Preparing land for irrigation						

BIBLIOGRAPHY

(1) Alampi, Phillip. A Farm Shop Program for the Woodstown High School Area. Thesis, M. E. Rutgers University. 1945.

(2) Bebermeyer, Paul. The Teaching of Farm Shop in Missouri High Schools. Thesis, M. S. University of Missouri. 1923.

(3) Geiger, James. A Study of Farm Shop Work in Florida. Thesis, M.A. University of Florida. 1932.

(4) Sharp, Marlay A. A Suggested Course of Study in Farm Mechanics for High Schools, Based on the Opinions of Five Hundred Farmers. Thesis, M. S. Iowa StateCollege. 1928.

(5) Stone, Archie A. Farm Machinery. New York: John Wiley and Son, 1934.

(6) Walker, Clyde. Determining the Content of Farm Mechanics Courses of Study for Smith-Hughes Agriculture Departments in High Schools. Thesis, M. S. University of Nebraska. 1931.

(7) Wright, J. C. and Allen, Charles R. Efficiency in Vocational Education. New York: John Wiley and Son, 1929. p. 54.